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Comparison of Open Reduction and Internal Fixation with PHILOS Plate versus Close Reduction and Fixation with Percutaneous K-wiring in Proximal Humerus Fractures

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ABSTRACT

Introduction: Fractures of the proximal humerus are the most common injuries in the upper limbs, especially in the elderly. Surgical options are available, including open reduction and PHILOS plating, as well as K-wire percutaneously reduced fixation, each with its advantages and disadvantages. **Objectives:** The study aims to discuss the clinical and functional outcomes of plate fixation using the PHILOS plate compared to K-wire fixation of proximal humerus fractures. **Materials and Methods:** This was a randomised controlled trial involving 144 patients treated at the Department of Orthopaedics, Allama Iqbal Teaching Hospital, DG Khan, between February 2024 to November 2024. The patients were separated into two categories, Group A (plating using PHILOS) and Group B (K-wire fixation). The result was evaluated using Neer's scoring system after 12 weeks. **Results:** Group A rated significantly higher in functional outcome, with 48.6% achieving an excellent outcome, compared to 27.8% in Group B. Complication rates were low in the PHILOS group. **Conclusion:** PHILOS plating represents a better functional outcome and fewer complications than the K-wire in the fixation of the proximal humerus fractures in the displaced proximal humerus fractures.

INTRODUCTION

Proximal humerus fracture (PHF) is an important clinical problem, especially among older adults who are affected by osteoporosis, which predisposes the age group towards getting fractured after experiencing a low-energy impact like a fall. They are the second most common upper limb fractures following distal radius fractures, and they pose significant disability and poor quality of life to persons who experience them (1). High-energy trauma, involving a road traffic collision, is the major cause of PHFs in younger patients (2). These fractures are treated in various ways, depending on the patient's age, bone quality, fracture type, and the surgeon's expertise. Although it is accepted that conservative management of less displaced fractures remains the standard care, producing good results in 80–85% of patients, as the displacement and instability of fractures increase, it is common to find that surgical treatment is the preferred intervention (3). Diverse forms of surgical procedures have been developed to address PHFs. They are closed reduction accompanied by percutaneous K-wire fixation, open reduction and internal fixation (ORIF) via compact plates (such as the Proximal Humerus Internal Locking System (PHILOS)), and finally, hemiarthoplasty or reverse total shoulder arthroplasty in the most extreme cases (4).

The most appropriate of these treatments would be PHILOS plating and percutaneous K-wire fixation, which is a common form of treatment for displaced fractures. The arsenal of these methods remains a debatable issue, and the outcomes of different studies present fluctuating results, depending on the union rate, the number of complications, and functional restoration (5). Closed reduction and percutaneous K-wiring have the benefits of being less invasive, causing less soft tissue disruption, resulting in less blood loss, and requiring less operative time. Such advantages make it especially practical for older and medically vulnerable patients. Nevertheless, this technique is associated with increased rates of premature fixation loss, migration of the pan, and poor control over complicated fractures (6). PHILOS plating, on the other hand, provides secure fixing of the fracture, especially on comminuted and osteoporotic fractures. Angular stability

is achieved by the locking mechanism of the PHILOS plate, allowing for early movement and functional recovery; however, the risk of soft tissue complications, screw cut-out, and infection is higher due to its more invasive nature (7, 8).

The evidence of PHILOS plate biomechanical supremacy has been documented with a greater frequency of use in the presence of osteoporotic bone, where the ability to achieve angular stable constructs lessens the incidence of secondary displacement (9). The low anatomical profile design minimises the risks of impingement as well. Liu et al. further demonstrated that the orientation and distribution of screws are critical in improving the stability of the construct, a finding corroborated by finite element modelling and biomechanical testing (10). Low-invasive K-wire fixation has yielded mixed results, particularly in complex fracture patterns treated with percutaneous methods. Research indicates that, although satisfactory outcomes are attainable, K-wiring fails to predict good functional recovery in two-part fractures, as well as in three- and four-part fractures (11).

A retrospective study comparing PHILOS plating with conservative treatment in elderly patients with displaced PHFs also demonstrated greater functional improvement and radiographic alignment in the PHILOS patients (Tammam et al. 12). Where possible, this study recommends the surgical use of locking plates based on conservative treatment that is usually recommended to older patients. Other studies comparing plating with either the dual or augmenter fixation have also reported the same biomechanical and radiological measures when using PHILOS plates, more particularly where the greater tuberosity was involved (13). According to research carried out by Agrawal et al., the PHILOS plating is a predictable technique of fixation that has a low rate of complications and good postoperative functional recovery (14). El-Geoshy et al. directly compared PHILOS plating with percutaneous K-wiring in a group of elderly patients. Their findings reported that, despite similar radiological rates of healing in both techniques, PHILOS plating showed improved range of motion and lower complication rates within a 6-month period of follow-up (15).

The minimally invasive plate osteosynthesis (MIPO) techniques through PHILOS plates have also demonstrated favourable outcomes in soft tissue damage reduction and enhanced healing, closing the gap between ORIF and percutaneous methods (16). Still, there are difficulties in the use of PHILOS plating. Saito et al. described a case of periprosthetic fracture treated with PHILOS plate fixation after reverse total shoulder arthroplasty, demonstrating the complexity and hazards associated with the process (17). Similarly, randomised studies such as that of Bhakare et al. have revealed that PHILOS plating and percutaneous K-wire fixation may both provide satisfactory outcomes in two- and three-part fractures, but plating is associated with higher functional scores and reduced complications (18). New meta-analyses also confirm this conclusion. A systematic review conducted by Suroto et al indicated that reverse total shoulder arthroplasty should have better outcomes than ORIF in elderly patients and had better outcomes in terms of anatomical fracture resolution when compared to PHILOS plating in 4-part fractures of patients with intact rotator cuffs and less complex fractures (19). This evidence supports the importance of selecting the patient and offering a personalised strategic plan of surgery to determine the most suitable form of fixation.

Objective

To compare the clinical and functional outcomes between open reduction and internal fixation with PHILOS plate and closed and percutaneous K-wire fixation in patients having proximal humerus fractures.

MATERIALS AND METHODS

Study Design: Randomized Controlled Trial.

Study Setting: The research was conducted in the Department of Orthopaedics at the Allama Iqbal Teaching Hospital in DG Khan.

Duration of Study: The study was conducted over 9 months, from February 2024 to November 2024.

Inclusion Criteria: Patients presented with closed proximal humerus fractures or fracture dislocations classified as Neer two-part, three-part, or four-part fractures, aged 20 to 70 years, of either gender. No patients was accepted after 2 weeks of injury, as the surgical intervention should be made very early.

Exclusion Criteria: Patients with open fractures, pathological fractures, and polytrauma or those who had been with more than two weeks of fracture or those who had any evidence of contraindications to surgery and general anaesthesia were excluded.

Methods

Patients were enrolled in the orthopaedic department after obtaining ethical approval and confirming that they were willing to participate in the study and met the inclusion criteria. Participants gave informed consent. All patients have been randomly selected and placed into two groups of 72 each using a sealed opaque envelope lottery. Patients in Group A underwent open reduction and internal fixation with the PHILOS plate, whereas patients in Group B underwent closed reduction and percutaneous K-wire fixation. All surgeries were performed by consultant orthopaedic surgeons who have at least five years of experience following their fellowship. Arm and shoulder immobilisation with an arm sling is applied to all patients postoperatively, and passive or pendulum exercises are begun on the third day. Active-assisted mobilisation was restricted to 90 degrees within six weeks, during which physiotherapy was structured and supervised. The outcomes were measured on a scoring system developed by Neer by the 12th week. A standardised proforma was employed to record all data, and SPSS version 22 was used to analyse .

RESULTS

A sample of 144 patients who had proximal humerus fractures was used in the study. The average age of the participants in Group A (PHILOS) was 48.3 ± 12.7 years, compared to 46.9 ± 11.9 years in Group B (K-wire). Most patients in both groups were male (61 in Group A and 58 in Group B). Falls were the predominant mode of injury in both sets of patients.

Table 1
Demographic and Clinical Characteristics of Study Participants

Variable	Group A (PHILOS)	Group B (K-Wire)	p-value
Number of patients	72	72	–
Mean age (years)	48.3 ± 12.7	46.9 ± 11.9	0.58
Male, n (%)	44 (61.1%)	42 (58.3%)	0.74
Female, n (%)	28 (38.9%)	30 (41.7%)	
Mechanism – Fall	46 (63.9%)	49 (68.1%)	0.56
Mechanism – RTA	26 (36.1%)	23 (31.9%)	

The classification of the fractures was in line with the Neer system. The most prevalent type of fracture in both groups was a two-part fracture, followed by three-part and four-part fractures.

Table 2
Fracture Type Distribution According to Neer Classification

Fracture Type	Group A (PHILOS)	Group B (K-Wire)	p-value
Two-part	31 (43.1%)	34 (47.2%)	0.79
Three-part	26 (36.1%)	24 (33.3%)	
Four-part	15 (20.8%)	14 (19.5%)	

The functional scores were measured using the Neer scoring system at 12 weeks postoperatively. There were 35 (48.6%), 20 (27.8%), 26 (36.1%), 30 (41.7%), and 6 (8.3%) fair, Satisfactory, Excellent, and failure outcomes in both groups, respectively.

Table 3
Comparison of Functional Outcomes Based on Neer's Score

Outcome Category	Group A (PHILOS)	Group B (K-Wire)	p-value
Excellent (>89)	35 (48.6%)	20 (27.8%)	0.03*
Satisfactory	26 (36.1%)	30 (41.7%)	
Unsatisfactory	6 (8.3%)	6 (8.3%)	
Failure (<70)	5 (6.9%)	6 (8.3%)	

*Statistically significant difference ($p < 0.05$)

PHILOS patients showed more promising results in terms of functionality as compared to the K-wire patients. There is no statistically significant difference in demographic or fracture type distribution, so the basis between the two groups can be assumed to be similar.

DISCUSSION

PHFs are more frequently seen in orthopaedic practice among the elderly, with their osteoporotic bones, and in those of a younger age involved in high-energy collisions. The method of dealing with displaced PHFs is still evolving, and several fixation methods can be applied. In this research presented, it became evident that the open reduction and internal fixation technique (with PHILOS plate) has better functional results than the closed reduction and percutaneous K-wires technique at 12-week follow-up (1). The PHILOS group also had 48% of its patients score an excellent rating on the Neer scoring method, compared to 32% % patients. These findings are not new, as previous research has also highlighted the biomechanical superiority and stable fixation quality of locking plates, such as PHILOS, particularly in osteoporotic or comminuted fractures.

Similar results were obtained by Sata et al., who suggested that PHILOS plating after surgery yielded favourable outcomes, especially in surgical neck fractures, due to its capacity to restore stable fixation and retain the anatomical reduction. PHILOS plates, due to their pre-contoured shape, which locks in, enable angular integrity, increasing varus collapse or resistance and rotational stability forces. Furthermore, the plate itself is located at the lateral side of the humerus, and the threat of subacromial impingement is avoided, which it carries when using ordinary plates (4). K-wire fixation is a minimally invasive procedure with a shorter average operation time, less blood loss, and fewer disruptions to soft tissues. It is a favourable surgery for elderly patients or those unfit for surgery at a low level (6). However the benefits of these techniques are usually proportional to the limitations of these techniques, particularly in the treatment of complex fracture configurations.

Our findings are in agreement with those of Buchmann et al., whowho compared MIPO with traditional open reduction techniques based on the same operation technique and found no reduction in outcomes, as PHILOS plates can be modified to cause less surgical morbidity without compromising the biomechanical advantages associated with them (5). In this regard, the application of PHILOS plating constitutes a balance between stability and minimally invasive procedures when applied through MIPO procedures. Patel et al. and Agrawal et al. also agree that PHILOS plating is better because it reduces postoperative complications and increases Neer scores compared to conventional or percutaneous procedures (7, 13). Although the two methods in our study had similar distributions of Neer types of fracture, the PHILOS group had a higher rate of anatomical alignment and good functional outcomes at 12 weeks. This highlights the role of stable internal fixation in facilitating early mobilisation, which is an important factor in preventing joint stiffness, a major complication in shoulder fractures.

However, one must remember that PHILOS plating does not entail zero risks. Other reported complications include screw penetration, avascular necrosis, infection and loss of hardware, especially in poorly performed surgical procedures or mal-adjusted plate positioning (8). The complications were minimal in both groups, but K-wire migration and superficial infection occurred predominantly in Group B, which is consistent with the existing literature (17). El-Geoshy et al. made a comparison between PHILOS fixation and K-wire. However, the results were more pronounced in elderly patients, and the PHILOS group showed superior shoulder outcomes, with no statistically significant difference in union rates. Bhakare et al., in a randomised trial, found results of significantly better excellent-to-good in the PHILOS group, and, more specifically, in two- and three-part fractures. Our analysis confirms these conclusions and provides the data on the local setting in Pakistan where fracture patterns, patient adherence, and access to physiotherapy may not be as similar as in Western populations. Others have maintained that non-operative or minimally invasive procedures, such as K-wiring, can be sufficient in very elderly patients or those with low demands (12).

Nevertheless, as life expectancy and functional requirements of populations continue to rise, there is an ever-growing focus on more permanent fixations to facilitate as quick a recovery as possible and

independence. Comparative biomechanical positions have also alleviated PHILOS plating. Finite element analysis by Liu et al. showed that optimised screw orientation of PHILOS plates has a more positive effect on construct stability, especially on osteoporotic bone models (10). This is very applicable because the ageing population in our area is increasingly morbid with osteoporotic fractures that need surgical management. There is also an enhanced surgical strategy, such as large tuberosity augmentation with plating, which has been shown to achieve better results in complicated types of fractures (15). The current study does not lack limitations. The duration of the follow-up was limited to 12 weeks, and no range of motion was measured beyond this period. Moreover, even though consultants performed the surgeries, the various surgical techniques and adherence to post-operative care may have influenced the outcomes.

CONCLUSION

This paper was a comparison of open reduction and internal fixation with PHILOS plates and closed reduction and percutaneous K-wire pinning in proximal humerus fractures. The findings showed that PHILOS plating has significantly improved functional results, as measured by the Neer scoring, and this improvement is especially notable in two- and three-part displaced fractures. The PHILOS group demonstrated better quality outcomes, with excellent and satisfactory results, as well as a lower number of complications, compared to the K-wire group. Although percutaneous K-wire fixation is a cheaper and less invasive method, instability, pin migration, and less successful functional recovery have been associated with complex fracture patterns. Our results support the growing body of evidence that PHILOS plates are superior to other methods of fixing the shoulder, providing an effective way to achieve early mobilisation and improved shoulder function. However, patient selection, the expertise of the Accident and Emergency surgeon, rehabilitation services, and other variables must be taken into consideration to determine the most suitable form of fixation. To determine long-term outcomes and complications, further long-term follow-up is advised.

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